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GRADUATE SCHOOL

OF THE

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1897

GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1897

POSTOFFICE:

CHAMPAIGN OR URBANA, ILL.

COUNCIL OF ADMINISTRATION

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Dean of College of Agriculture

CALENDAR

1897-98

FALL TERM, 1897

Sept. 13, 14, Monday and Tuesday.	Registration Days.
Nov. 1, Monday.	Latest date for Announcing Subjects of Theses.
Dec. 23, Wednesday,	Term Examinations begin.
Dec. 24, Friday.	Term ends.

WINTER TERM, 1898

Jan. 4, Tuesday.	Registration Day.
March 21, Monday.	Term Examinations begin.
March 23, Wednesday.	Term ends.

SPRING TERM, 1898

March 29, Tuesday.	Registration Day.
May 31, Tuesday.	Latest Day for Acceptance of Theses.
June 1, Wednesday.	Term Examinations begin.
June 5, Sunday.	Baccalaureate Address.
June 6, Monday.	Class Day.
June 7, Tuesday.	Alumni Day and Oratorical Contest.
2 June 8, Wednesday.	Twenty-sixth Annual Commencement.

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GRADUATE SCHOOL

Organization

The graduate school is in charge of the Council of Administration of the University. The dean of the general faculty is the executive officer of the school, and he should be consulted on all matters pertaining thereto.

Admission and Registration

Graduates of the University of Illinois, and of other colleges and universities of approved standing, may be admitted to membership in the graduate school upon presentation of their credentials. Other persons suitably qualified may gain admission by special vote of the Council of Administration upon such conditions as may be imposed in each case.

Registration may be accepted at other times, but the time-limit required for degrees counts from the date of registration. In all cases one registration covers an academic year or such fractional part thereof as then remains.

With the exceptions named below, all members of the graduate school are required to be in regular attendance at the University, and to do all the work for which they are registered in the departments to which such work belongs. Graduates from baccalaureate courses of the University of Illinois may register as non-resident members of the graduate school; and all members of the school who have completed the resi-

dence period required for advanced degrees may register as non-residents while completing the work required for such degrees.

Studies and Examinations

Each student must select one principal line of study, called his major subject, and upon this major subject at least one-half of his work must be done; and any greater proportion of his time, up to the whole of it, may be thus devoted if proper approval is had. When work upon the selected major subject is not arranged to require all of the student's attention, he must choose one or two minor subjects, as may be necessary to complete a full course of study.

The major study must be approved as graduate work for this University. For this purpose certain courses usually offered to undergraduates are open to graduates under such conditions as are prescribed in each case by the head of the department concerned. These courses are included hereafter in the list of subjects, and are also described under the appropriate departments in the general catalogue of the University. The requirements of preparatory study are given under the different group headings. The minor subjects may, upon approval, be chosen from the offerings to graduates, or, except in engineering, from undergraduate courses, exclusive of those usually open to freshmen.

In architectural and engineering subjects, at least the major line of study, and not less than two-thirds of the entire work, must be taken from lists marked "primary," and any remaining amount to complete a full course may be taken from those designated "secondary," under the same head with the primary list.

The head of each department in which a student does his major work is charged with the direction and supervision of such major work, and, in a general way, with the supervision of the student's entire course of study.

Instruction

In general, the instruction in courses open only to graduates consists in suggesting and directing courses of reading, in supervising investigations, and in conducting oral and written discussions. Members of the graduate school taking class work with undergraduates may be assigned extra reading or laboratory investigation. In all cases heads of departments exercise great freedom in adapting courses and methods of instruction to individual needs.

Degrees

Second Degrees.—The *second* degrees conferred by the University are as follows:

Master of Arts, after Bachelor of Arts.

Master of Science, after Bachelor of Science in Agriculture and Science.

Master of Architecture, after Bachelor of Science in courses in Architecture and Architectural Engineering.

Civil Engineer, after Bachelor of Science in the course in Civil Engineering.

Electrical Engineer, after Bachelor of Science in the course in Electrical engineering.

Mechanical Engineer, after Bachelor of Science in the course in Mechanical Engineering.

Each candidate for a second degree is required to register in the graduate school; to conform to the rules regarding registration, etc.; to pursue an approved

course of study for at least one academic year in residence, or in the case of graduates of the University of Illinois for three years *in absentia*; to pass satisfactory examinations upon all the studies of the approved course, and to present an acceptable thesis in the line of his major subject of study.

Doctor's Degree.—The degree of *Doctor of Philosophy* may be conferred upon any member of the graduate school of not less than three years' standing who shall have made high attainments in scholarship, including a sufficient knowledge of the Latin, French, and German languages to serve the purposes of research in his principal specialty; who shall have shown marked ability in some line of literary or scientific investigation; and shall have presented a thesis giving clear indications of such scholarship and of such power of research. At least the first two, or the last one, of the three years of study must be in residence at the University of Illinois, and the entire course of study must be in accordance with the regulations of the graduate school.

Fellowships

The Trustees of the University have established eight fellowships, each with a stipend of three hundred dollars, payable in ten monthly instalments.

Nominations to fellowships, accompanied by assignments to special departments of the University for instructional work, are made by the Council of Administration to the Trustees of the University, upon applications received by the President of the University each year, not later than the twenty-fifth day of April.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attain-

ments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Consideration also is given to the probable value or usefulness of the services of the candidate as an assistant in instruction. Other things being equal, preference shall be given to those who have pursued a course of undergraduate work in which a major subject has been made a leading feature through two or more years.

Candidates must present, with their applications, full information concerning themselves and their qualifications for advanced study and research work, including any written or printed essays or results of investigation, and must name the subject in which they wish to do their major work.

Fellowships are good for one year. Appointments may not usually be renewed to the same persons, and in no case for more than one additional year; but an appointment as *honorary fellow*, without stipend, may be made as specified for paid fellowships in the case of any one who has held a regular fellowship and has shown distinguished merit in his work.

Libraries and Laboratories

The new library building, one of the best in the country, offers excellent facilities for the work therein conducted, and liberal appropriations of money make it possible in most cases to provide the necessary literature in special lines of research. There are now available to students 36,000 bound volumes and 21,000 pamphlets.

The chemical, physical, biological, geological and engineering laboratories afford abundant opportunities for research work. The agricultural experiment sta-

tion and the biological station on the Illinois river, each offers special advantages for investigation. The astronomical observatory is well fitted for certain courses of practical study and research. All considered, the various laboratory equipments are equaled only in a few institutions in the country.

Expenses

The only fees in the graduate school are ten dollars for matriculation, to those not already matriculates of the University, and five dollars for diploma. Actual laboratory and similar expenses must be paid; otherwise there are no charges of any kind.

Board can be had in clubs or in private families at from three and a half to six dollars a week. The average price is from four to four and a half dollars.

RESIDENT GRADUATES

Individuals holding bachelor degrees not desiring to enter, or not eligible for membership in, the Graduate School, may gain admission to the University as "resident graduates" and may elect such undergraduate courses as their previous training justifies. Such students may enter for a bachelor's degree from the University.

COURSES OF INSTRUCTION

An asterisk (*) indicates that the course it precedes is primarily for undergraduates, but is open to graduates as major work subject to the conditions prescribed by the head of the department. Courses without an asterisk are offered only to graduates.

Unless otherwise stated the work continues through the year. Information concerning the number of hours a week must be obtained by inquiry.

Indications are given under the group headings of the amount of preparatory study required for admission to the courses, expressed in years of undergraduate instruction as given in the University of Illinois, or an accepted equivalent. Of course this is exclusive of the requirements for admission to undergraduate work. In all cases admission is conditioned on the approval of the heads of the departments concerned.

LANGUAGE AND LITERATURE

Admission requirements: In Greek, Latin, French, and German, three years; in English, two years.

GREEK—PROFESSOR MOSS

Herodotus.—Selected portions for reading. Attention will be directed during the first half of the year to the text; during the second half to literary and historical criticism.

Plato.—Translation of selected dialogues, with critical study of a restricted group.

LATIN—PROFESSOR BARTON

Catullus.—Selected readings. The position of Catullus and Horace in lyric poetry; the indebtedness of Horace, Vergil, and the elegiac poets to Catullus.

The Elegiac Poets.—Selections from Ovid, Propertius, and Tibullus.

Roman Literary Prose Style.—Selected readings to trace in a connected manner the characteristics of prose style under the Republic, during the time of Augustus, and under the early Empire.

ENGLISH—PROFESSOR DODGE AND ASSISTANT PROFESSOR MERRILL

The courses in literature are:—
*Old English Poetry.
*Fourteenth and Fifteenth Century Literature.
*Seminary in Comparative Modern Fiction.
*Shakespeare and the History of the Drama.
*History of English Criticism.
*Old English (Anglo-Saxon) Grammar and Prose.

*The linguistic courses are:—
*Early English.
*History of the English Language.
Icelandic.—Grammar and reading of prose.
Danish.—Grammar and reading of prose and poetry.

GERMAN—ASSISTANT PROFESSOR RHOADES, DR. SCHMIDT, MR. SMITH

*Study of Goethe.—Lectures on Goethe's Life and Works, with translation and collateral reading. In 1897-98 this course may be elected for the study of Goethe's lyrics, prose writings, and dramas, especially those of his classical period; in 1898-99, for the study of Faust and the Faust problem.

*History of German Literature.—Lectures and assigned collateral reading of English books bearing on the subject.

FRENCH—ASSISTANT PROFESSORS PIATT AND FAIRFIELD

*Eighteenth Century.—The course will consist of: (1) lectures in French, of themes and collateral reading; reading of selected works of Voltaire, Montesquieu, Rousseau, Chênier, and Beaumarchais. (2) Assigned readings. (3) Themes in French upon subjects connected with the course.

*Old French Readings.—(a) Clèdat, Les Auteurs Français du Moyen Age; Suchier, Aucassin et Nicolete; Gautier, La Chanson de Roland. Translation and comparison with the modern idiom. Study of the laws of phonetic changes. Lectures upon Old French philology. (b) A systematic study of special topics: French poets of the sixteenth century. Malherbe; his school and his influence. Sacred eloquence of the seventeenth century.

PHILOSOPHY, PSYCHOLOGY AND PEDAGOGY

Admission requirements: One year.

PHILOSOPHY—ASSISTANT PROFESSOR DANIELS

*Advanced Philosophy.—The work consists of a critical study of Lotze's Microcosmus together with supplementary readings and discussions upon suggested topics.

**The Philosophy of Kant.*—A critical study of the Critique of Pure Reason and the Critique of Practical Reason.

**Esthetics.*—A brief history and a critical study of the various theories of the beautiful.

PSYCHOLOGY—ASSISTANT PROFESSOR KROHN

Special Investigations.—A research course consisting in the investigation of special problems, the nature and scope of these investigations to be determined after consultation.

PEDAGOGY—PROFESSOR TOMPKINS AND ASSISTANT PROFESSOR MCGILVREY

**The Universal Law and Problem of Thinking.*—Special movements of the mind in learning discriminated. (1) How to think objects into organic unity. (2) How to think objects into class unity. *Fall term.*

**The Logical and the Psychological Factor in Educational Method;* that is, the foregoing process modified by the psychological factor. The sketching of lessons in recognition of the two factors. *Winter term.*

**Special Methods in Subjects*, as determined by the logic of the subject and by the learning mind. These exemplify in concrete operation all the foregoing laws. *Spring term.*

The Nature and Purpose of Education as revealed in the nature and purpose of human life, as interpreted in Literature and Philosophy.

The History of Educational Ideals and Theories, as tested by the standard developed in the foregoing.

Universal Method in Education as determined by the three organic phases of life—logical, ethical, esthetical.

The Course of Study as determined by the logical and psychological factors in education.

The Philosophy of School Organisation, Management, and Supervision as determined by the purpose and process of education.

School Systems, past and present, as determined by their historical setting and by the educational theories of the times.

ECONOMICS, HISTORY, AND PUBLIC LAW AND ADMINISTRATION

Admission requirements: One year.

ECONOMICS—PROFESSOR KINLEY

**Public Finance.*—The purpose of this course is the historical comparative, and critical study of the methods and purposes of public

expenditure, and of the different sources of revenue, and also the discussion of public debts, their placement, refunding and redemption. Those who enter the course must take both terms' work. Graduate students will receive credit as such for the course, providing they do additional reading assigned in Wagner, Cohn, Beaulieu, and other writers, and also prepare one extended paper, or two shorter ones, on topics connected with the course. *Fall and winter terms.*

**Financial History of the United States.*—This course begins with Hamilton's administration of the treasury. It deals with the growth and management of the national debt, and with the industrial expansion and the tariff history of the country. While the necessary logical separation is observed in the treatment of these subjects, their intimate connection is also emphasised and the economic development of the country as a whole is studied. The course may be taken as a graduate course on conditions similar to those laid down above. For graduate students the course will be purely investigative. They must, however, attend the lectures and report from time to time the results of their special investigations and summaries of their additional assigned reading. *Fall and winter terms.*

[The above courses are given in alternate years.]

**Taxation.*—This is a course in the theory of taxation. It is both historical and critical. The theories of different writers are studied from their works, so far as the library facilities permit, and in such order as to show the historical evolution of the modes of taxation, the theories underlying them, and the general relation of these theories to the prevailing political philosophy. *Spring term.*

Principles of Economics (Advanced Course).—This course is a study of economic theory, beginning with the Physiocrats. Special attention is paid to recent development. It is based on Smith, Mill, Cairnes, Marshall, Roscher, Knies, Wagner, Böhm-Bawerk, Clark and Patten.

Seminary.—Advanced students are formed into a seminary for investigation and for the study of current economic literature. *Two hours once a week through the year.*

HISTORY—ASSOCIATE PROFESSOR GREENE AND ASSISTANT PROFESSOR ALDEN

**American Constitutional and Political History.*
**Mediaeval History and Institutions.*
**Europe in the Fourteenth and Fifteenth Centuries.*
**Europe from the Age of Louis XIV. to the Present Time.*
Seminary in American History.
Seminary in Mediaeval History.

PUBLIC LAW AND ADMINISTRATION—ASSISTANT PROFESSOR TOOKE

Comparative Constitutional Law.
Comparative Administrative Law.
International Law.
Roman Law.
Seminary in Constitutional Law.

NATURAL and PHYSICAL SCIENCE and MATHEMATICS

Admission requirements: One year in Botany, Zoology, and Physics; two years in Chemistry and Mathematics; one term in Mineralogy, and two terms in Geology, Physiology, and Astronomy.

BOTANY—PROFESSOR BURRILL AND MR. HOTTES.

Bacteriology.—This course is an introduction to existing knowledge upon the subject, and offers instruction in the modern methods of experimentation and research.

Systematic Botany.—The morphology and affinities of selected orders of flowering plants, herbaria and herbarium methods, studies upon the evolution of the vegetable world, are included in the work of the first term. The second term is devoted to cryptogamic plants and the time is largely occupied in the determination and classification of species, together with studies upon life histories. *Fall and winter terms.*

Reproduction and Development.—Special experimental and research work in vegetable physiology, embryology, and life histories. Mostly laboratory work. *Spring term.*

Economic Botany.—A study of useful and harmful plants, especially those affecting agricultural and horticultural interests and of prominence in the arts. *Winter term.*

Biological Botany.—The preparation and study of material by histological methods; and experiment work with living vegetation in the laboratory and field in working out special problems in the development, physiology, and pathology of plants.

Systematic Botany.—Critical and comparative studies of species included in chosen groups of spermaphytes or sporophytes, or from selected geographic areas, in connection with considerations of genealogic development, geographic distribution, and inter-related association.

Advanced Bacteriology.—Investigations upon morphologic and physiologic variation due to treatment; systematic studies upon the number, validity, and relationship of species; researches upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities.

Evolution of Plants.—Observations and experiments upon plants, and studies in related literature, in gaining information upon such topics as the following: The influence of environment, effects of self and cross fertilization, tendencies of variation, philosophy of selection, nature and laws of heredity.

ZOOLOGY—PROFESSOR FORBES, AND ASSISTANT PROFESSOR SMITH

**Embryology.*—This course begins with a study of the germ cells, and the process of maturation, fertilization, cleavage, and gastrulation from preparations furnished to the student. The study of the development of the vertebrate form in the chick is then taken up, with preparations of the amphibian embryo for comparison. Instruction is given in methods of preparing embryological material.

**Advanced Zoology.*—Four main lines of work are provided for: (*a*) Systematic reading of general zoology together with lectures on the morphology, physiology, and œcology of special groups. (*b*) Seminary work, consisting of the collating, indexing, and abstracting of a scattered literature on assigned or selected subjects, and the preparation of papers based on these bibliographical and literary studies. Regular instruction in natural history drawing sufficient to enable the student to prepare illustrations for reproduction by the ordinary methods will be made part of this course. (*c*) Zoological research work, which will usually take the form of an original investigation of a limited subject, carried forward with whatever aid, guidance and instruction the nature of the subject and the ability of the student may require. (*d*) Pedagogical zoology, offered with special reference to those who wish to become teachers of biological subjects.

**General Entomology.*—It is intended that the student shall come through this course accomplished in all the methods of the zoological laboratory as applied to entomology, competent to determine, to draw, and to describe species, and experienced in the various operations of field, laboratory, library, and economic entomology.

Advanced Entomology.—Special courses will be arranged in either technical or practical entomology for students wishing to specialize extensively in this direction. Special provisions will be made for the instruction and supervision of students desiring to fit themselves for the investigation of the contagious diseases of insects.

Systematic and Faunistic Zoology.—This course consists of studies of invertebrate animals (including insects), and of aquatic vertebrates, so directed as to give as nearly as possible an exhaustive knowledge of a taxonomic group or of a selected geographic assemblage. If a suitable taxonomic group is chosen, its space and number relations within a definite area will be thoroughly worked out by the precise

methods of modern faunistic zoology, including quantative collections made by uniform methods at regular periods, and the comparative measurement or enumeration of such collections. If a geographic assemblage be selected, critical determinative work will be followed by both qualitative and quantative studies of the various groups associated, with a view to accumulating data for an examination of the interactions of the assemblage.

Advanced Economic Entomology.—This is a research course in systematic and experimental entomology with application to insects injurious to agriculture and horticulture. It is intended to prepare students in a thoroughgoing manner for first-class investigation work in this field, and for the direction of entomological operations in agricultural experiment stations.

PHYSIOLOGY (HUMAN)—ASSOCIATE PROFESSOR SUMMERS

**Advanced Physiology.*—There are here included the following lines of laboratory work, any one or more of which may be pursued independently of the others. (a) The physiology of foods, digestion, and exertion; (b) the blood, circulation, and respiration; (c) the excretions, especially urinalysis; (d) general physiology of nerve and muscle; (e) advanced vertebrate, especially human, histology.

**Nervous System.*—Daily lectures, with illustrative laboratory work, on the physiological anatomy and functions of the nervous system of man. *Spring term.*

GEOLOGY AND MINERALOGY—PROFESSOR ROLFE AND MR. MOSIER

**Economic Geology.*—This course is devoted to a study of the uses man may make of geologic materials, the conditions under which these materials occur, and the qualities which render them valuable.

Advanced Economic Geology.—The effects which variations in the chemical composition and physical constitution of inorganic substances used in the arts have on the qualities of the manufactured product, and should have on methods of manufacture. A critical examination of the tests now employed in determining the qualities of building stones.

**Advanced Mineralogy.*—Crystallographic Mineralogy. A careful study of the forms of crystals, including the measurement of angles and determination of complex forms; identification of minerals by their crystalline forms.

Optical Mineralogy. The microscopic determination of rock forming minerals; methods of separating the mineral constituents of fine-grained rocks, etc. *Winter and spring term.*

**Paleontology.*—This course includes: (a) A discussion of the bio-

logical relations of fossil forms; (b) a discussion of the principles of classification as applied to fossils, together with the characteristics which distinguish the larger groups; (c) a study of the distribution and variations of the genera and species of one or more of the more important groups.

Advanced Paleontology.—A critical and comparative study of the fossils found in the rocks of Illinois.

Illinois Geology.—Glacial geology in relation to water supply of drift-covered regions. Dynamic and stratigraphic geology of the Ozark uplift in Illinois.

CHEMISTRY—PROFESSORS PALMER AND PARR, ASSISTANT PROFESSOR GRINDLEY, MR. ROSE, AND MR. KEELER.

**Volumetric Analysis.*—Silicate analysis.

**Food and Air Analysis.*—Plant products, feeding stuffs.

**Technological Chemistry.*

**Physical Chemistry.*

**Iron and Steel Analysis, etc.*

**Advanced Organic Chemistry.*

**Sanitary Analysis.*—Waters, etc.

**Theoretical Chemistry.*

**Agricultural Chemistry.*

**Metallurgy.*

**Metallurgical Chemistry.*—(*a*) Electro-Metallurgy; (c) Electro-Chemical analysis.

**Industrial Chemistry.*—(*a*) Gas analysis; (*b*) Urinalysis; (c) Toxicology.

**Seminary.*—Journal readings, reviews, etc.

**Proximate Organic Analysis of Foods, Plants, Drugs, Compounds, etc.*—Research work in inorganic chemistry, in general organic chemistry, in agricultural chemistry, and in metallurgical chemistry, including such special topics as the composition of foods, their nutritive and heat values; the determination of the heating power of fuels, analysis of ores, etc.

PHYSICS—PROFESSOR CARMAN, ASSISTANT PROFESSOR SAGER, AND MR. QUICK.

Electrical and Magnetic Measurements.—An advanced lecture and laboratory course in the theory and use of electrical and magnetic measuring instruments.

Advanced Physical Measurements.—A laboratory course supplemented by recitations and lectures.

Introduction in Theoretical Physics.—A course of lectures and recitations, taking up dynamics, fall term; theory of electricity and

magnetism, or optics, winter term; and thermodynamics or optics, spring term.

Investigation of Special Problems.—An advanced laboratory course. The student is given one or more special subjects of investigation to be conducted throughout the year.

Mathematical Physics.—A course of lectures and recitations. The subjects 1897-98 are theory of electrical and magnetic potential, and Maxwell's Theory of Electricity and Optics, using in the latter course Boltzman's and Poincare's lectures as references.

Advanced Physical Measurements and Investigation.

Advanced Mathematical Physics.

ASTRONOMY—ASSOCIATE PROFESSOR MYERS

**Cosmogony.*—The chief aim of this course is to acquaint the student with the evidence for and against the Nebular Theory. The role of the tides in cosmogonic development receives special consideration, and the present view, together with the testimony furnished by astronomy relating to the origin and cosmic history of the earth-moon system is recapitulated in detail to the epoch where astronomy yields to geology. A summary of the researches of Darwin and of Lord Klevin is included.

**Practical Astronomy.*—This course is intended to give the student training in the use of instruments of precision. As a concrete outcome of the above training, the student would acquire the ability to determine latitude, time, and azimuth with such instruments as are used in the ordinary practice of civil engineering.

**Theory of Orbits.*—This course embraces the following subjects: The formation and integration of the differential equations of motion of a system of bodies and the deriviation of the laws of undisturbed elliptic, parabolic,, and hyperbolic motion. The actual computation of a cometary or planetary orbit is usually made. Fall term.

**Special Perturbations.*—An investigation of the various formulæ and methods for finding the special perturbations of a heavenly body constitutes the chief subject of this course. *Winter term.*

**Celestial Mechanics.*—The laws of motion of a system of bodies are here developed, the usual differential equations being treated.

**Astronomical Seminary and Thesis.*--This course is given in conjunction with Astronomy 7, 8, and 9, or with Mathematics 20, 21, and 22, according as the one or the other is current.

MATHEMATICS—PROFESSOR SHATTUCK, ASSOCIATE PROFESSORS TOWNSEND AND MYERS.

**Theory of Equations.*—Fall term.

**Theory of Determinants.*—The origin and notation of determinants, properties of determinants, determinants of special forms

with applications to algebra and to analytic geometry. *Winter term.*

**Theory of Invariants.*—The course will cover the general development of the theory of invariants, both from the geometric and from the algebraic side. [Note not given in 1897-98]

**Theory of Functions.*—By way of introduction, attention will be given to the geometric representation of the complex variable. This will be followed by the development of the theory of infinite series, algebraic and transcendental functions, integration of uniform functions Riemann's surfaces, introduction to elliptic functions, etc. *Fall and winter terms.*

**Method of Least Squares.*—The following subjects will be studied: Law of probability and error, adjustment of observations, precision of observations, independent and conditioned observations, etc.

**Seminary.*

**Differential Equations.*—This subject is designed for students in the courses in engineering and in mathematics and astronomy. *Winter term.*

**Analytical Geometry of Space.*—A general review of the position of the plane and the right line in space and the more general properties of surfaces of the second degree, the classification and special properties of quadrics, and a brief introduction to the theory of surfaces in general. *Spring term.*

**Higher Plane Curves.*—This course is designed to cover the general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves. Special study will be made of curves of the third and fourth order. *Winter term.* [Not given in 1897-98].

**Calculus of Variations.*—This course has for its aim merely to acquaint the student with those elements of the science which are most needed in the study of the higher subjects of mathematical astronomy and physics. *Fall term.*

**Spherical Harmonics.*—Fourrier's Theorem for developing any function of a variable in a series proceeding in sines and cosines of multiple of the variable is derived and the limitations of its validity investigated. This is followed by the study of Lagrange's, Laplace's, and Larne's functions and their applications to astronomical and physical problems. *Winter term.*

**Potential Function.*—The potential function is defined and its properties derived and discussed. The potential of various bodies, such as a wire, a spherical shell, a sphere, ellipsoid of revolution, etc., is computed. Poisson's and Laplace's Equations are derived and discussed. *Spring term.*

**Modern Geometry.*—This course will include in general a consid-

eration of homogeneous co-ordinates, duality, descriptive and material properties of curves, anharmonic ratios, homography, etc. *Fall term.*

**Algebraic Surfaces.*—In this course will be considered the application of homogeneous co-ordinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Fall term.* [Not given in 1897-98.]

AGRICULTURE

Admission requirements: One year each of chemistry and of biological science.

PROFESSOR DAVENPORT, AND ASSISTANT PROFESSOR HOLDEN.

**Economic Agriculture.*—A study of the influence of physical surroundings and of the elements of fertility upon the yield and the character of agricultural crops. Reaction of different crops upon the soil and upon one another when grown together or in succession. Economic sources of fertility, especially of nitrogen through the agency of bacteria.

**Soils.*—A critical study of the processes active within the soil; influence of fertilizer and of crop upon the soil; natural sources of fertility, residues or the fate of fertility, as shown by a study of drainage waters; agency of bacteria and the conditions of their activity, and the cumulative effect of manures and of various agricultural practices. *Fall term.*

**Laws of Organic Evolution as Concerned in the Breeding of Domestic Animals.*—The nature and extent of variation and its importance as affording the means for improvement by selection. Natural selection; heredity; causes of variation; crossing; correlated variation; continuity of protoplasm and the inheritance of acquired characters.

**Principles of Stock Feeding.*—Functional activities of the animal body and the end products of their metabolism. Foods are considered, first, chemically, as affording the materials for these activities; second, dynamically, as affording the potential energy for effecting these transformations as well as for the performance of outside labor.

**Agricultural Experimentation.*—A systematic study of the work of experiment stations and experimenters in this and other countries, together with a critical study of correct principles and methods of experimentation, especially designed for such students as desire to fit themselves for work in original investigation in experiment stations or elsewhere.

**Comparative Agriculture.*— Influence of locality, climate,

soil, race, customs, laws, religion, etc., upon the agriculture of a country and upon its people. One crop only and its effect, as rice, Indian corn in American agriculture and affairs. Varying conditions under which the same crop may be produced, as wheat. Influence of machinery and of land titles, whether resting in the government, in landlord or in occupant. Relation of agriculture to other industries and to the body politic.

ARCHITECTURE AND ENGINEERING

Admission requirements: The undergraduate course in the College of Engineering.

ARCHITECTURE AND ARCHITECTURAL ENGINEERING—PROFESSOR RICKER, ASSOCIATE PROFESSOR WHITE, ASSISTANT PROFESSOR MCLANE, AND MR. TEMPLE.

Primary. Each 1, 2 or 3 credits.

Construction of Extensive Wooden Buildings.—Foundations; floors; walls; roofs; economic spacing of columns, girders and trusses.

Recent Uses of Stone, Brick and Terra Cotta in Architecture.—Stone columns, beams, lintels, and walls. Brick walls, piers, screen walls. Terra cotta walls, columns, architraves, cornices, internal finish.

Metallic Skeleton Buildings.—Cantilever foundations; wind-bracing; economic spacing of beams, columns, girders, and roof trusses; economics of arrangement and construction.

Fire-Resisting and Fire-Proof Buildings.—Methods of construction used and proposed; results of tests and fires; comparative returns from investments.

Sanitation of Public Buildings.—Water supply and sewerage of isolated buildings; examination of examples; proposal of improvements; estimates of cost.

Researches on Evolution of Architectural Styles.—Development of column, pier, entablature, window, and door; changes in uses of architectural elements; modifications in plans, elevations and uses of buildings; influences of climate, materials, and man; progressive decoration.

Higher Application of Graphic Statics.—The kern and compression; statics of Gothic structures; steel and tile or concrete vaults and dams; deflection curves of loaded beams and girders; economics of large roofs.

Heating and Ventilation of Large Buildings.—Comparison of

systems; study of executed examples; designing plant for isolated public building; economics of heating and ventilation.

Higher Studies in Architectural Design.—The work of an entire term will be devoted to a single problem, a large public or semi-public building; the design will be most important, but sufficient attention must be paid to construction, heating, lighting, etc.

Researches and Experiments in Applied Esthetics.—Application of theories of geometrical proportions to selected buildings; measurement of proportions of architectural elements in best styles; experiments in variations.

Translation of Architectural Works from French or German—Summary data; condensations; complete translations in clear, idiomatic English.

Secondary. Mostly 1 credit each.

Stereotomy Applied to American Problems.—Arches, straight or skew; vaults, groin or cloister; domes and pendentives; staircases and stairway vaults.

Examinations of Heating and Ventilation of Buildings.—1, 2, or 3 credits. Inspection of completed plants and reports thereon; tests of apparatus; efficiency of arrangement; economy of working.

Higher Workshop Practice.—Inspection of wood-working mills, of architectural iron works, of marble works, terra cotta works, examination of processes employed and reports thereon.

Photography for Architects.—Theory and practice of dry plate photography; making negatives of exteriors, interiors, details, and drawings; printing processes.

Methods of Reproducing Drawings and Specifications.—Hektograph, mimeograph, blue prints, black prints, colored prints; other processes; drawing for photographic processes.

Higher Problems and Methods in Perspective.—1, 2 or 3 credits. Shadows in perspective; oblique perspective; abbreviated methods; reflections.

Estimates and Specifications for Large Buildings.—Study of examples; collection of data; general and detailed estimates; outline and complete specifications.

Higher Industrial Design.—1 or 2 credits. Sketches and working drawings for furniture and ornamental work for buildings.

Advanced Water Color Painting.—Rendering in ink, sepia, or color.

Office Methods and Arrangement.—Arrangement of offices for architects; storage of supplies and of drawings of completed work; filing drawings, specifications, etc., of work in progress; book-keeping for buildings; forms of official papers.

Any Primary Offered in Engineering Subjects.

Indexing and Classification of Periodicals, Books, etc.—Collecting and filing data; decimal system; materials; arrangement of clippings; indexing periodicals, filing drawings.

CIVIL ENGINEERING—PROFESSOR BAKER, ASSISTANT PROFESSOR PENCE, AND MR. KETCHUM

All subjects are primary unless otherwise stated.

Railway Engineering

Location and Construction.—Advanced work in the economic theory of railway location with relation to the effects of distance, grade, and curve upon operation and maintenance. Estimates, specifications and contracts, and the improvement of existing lines of railway.

Railway Track and Structures, and Their Maintenance.—The design of track standards and of minor railroad structures, trestles, culverts, turn-tables, water tanks, engine houses, etc., with special reference to economic principles of construction and maintenance.

Yards and Terminals.—The arrangement of tracks, buildings, etc., at division and terminal points with reference to economy and facility in handling traffic. Personal inspection and report on actual cases.

Motive Power and Rolling Stock.—Locomotive construction and performance, and car building and repairs.

Signal Engineering.—A study of the various systems of railway signaling. Personal inspections and comparisons of different plants in actual operation.

Railway Operation and Management.—The organization and administration of the several branches of service in railway operation.

Structural Engineering

Bridge Design.—A comparative study of the details of standard designs, with personal inspection of the process of manufacture and erection.

Cantilever and Swing Bridges.—The computation of stresses, design of parts, method of erection, etc.

Metallic Arches.—Computation of stresses and design of metallic arches.

Metallic Building Construction.—The computations and drawings of a design for a metal skeleton building, with a consideration of standard connections.

Roof Construction.—Computations of stresses and design of steel roof trusses.

Stereotomy.

History of the Development of Bridge Building—Secondary.

Miscellaneous Subjects

Practical Astronomy.—Practice with the astronomical transit, zenith telescope, and alt-azimuth in determining time, latitude, and azimuth.

Geodesy.—A study of the methods employed in triangulation, with practice in reading angles; base-line measurements; method of least squares and adjustments of triangulation systems; map projection; trigonometrical leveling.

Critical Description of Engineering Construction.—Details of methods and cost from personal inspection during progress of construction.

Translation of Technical Engineering Work from French or German.

Any Primary in Theoretical and Applied Mechanics, or Municipal and Sanitary Engineering.

Any Subject in Mathematics, or any Primary in Mechanical Engineering, or Electrical Engineering—Secondary.

Indexing of Civil Engineering Periodical Literature.

ELECTRICAL ENGINEERING.—PROFESSOR CARMAN, ASSISTANT PROFESSORS SWENSON AND ESTY

Mathematical Theory of Electricity and Magnetism.—Lectures and recitations with Mascart and Joubert's Electricity and Magnetism as text book.

Absolute Measurements in Electricity and Magnetism.—Laboratory course in investigation of special problems.

Dynamo Electric Machinery.—Laboratory course in the study of some of the machines belonging to the department, including alternating current apparatus.

Electric Transmission of Power.—Course of lectures, with study and design of electric stations acording to the best engineering practice.

Electro-Metallurgy.

Photometry.

In addition to the above courses, minor courses may be taken in mathematics, physics, chemistry, and in any of the engineering courses.

MECHANICAL ENGINEERING—PROFESSOR BRECKENRIDGE, ASSISTANT PROFESSOR VANDERVOORT, MR. WOOD, MR. GOODENOUGH.

Advanced Machine Design.—The work offered under this head embraces a wide range of subjects, and will be arranged along any special line that may be considered profitable for the student.

Graphics and Kinematics.—The application of graphical methods of solution of problems; advanced valve-gear problems; acceleration and velocity diagrams of governors; quick return motions; other important mechanisms.

Mill Engineering.—A study of problems arising in connection with installation of power plants and transmission of power.

Steam Engineering.—A study of theory and practice of steam generation and use. This may be taken as applied to marine practice, to locomotive practice, to steam heating, or to stationary steam engines and boilers. Advanced study of theory of the steam jacket and of superheating; multiple expansion engines; steam turbines.

Experimental Engineering.—Review of standard methods of testing applied to all forms of motors, or steam generating apparatus. Numerous experiments and carefully prepared reports are required.

Thermodynamics.—Advanced study of theory of heat engines. Solution of numerous problems.

Pneumatics.—A study of air compressors and of air transmission; air motors; blowing engines; fans and blowers. Theory of design and operation. Problems.

Hydraulic Machinery.—A study of high and low duty pumping engines; hydraulic transmission of power; centrifugal and rotary pumps; hydraulic presses, elevators, and cranes.

Mechanical Technology.—Installation and economic arrangement of machinery. Shop management and systems. Construction of special machine tools. Construction of machinery used in various lines of manufacturing.

Translation of Technical Engineering Literature.

Any Primary Offered in the College of Engineering.—Secondary.

Indexing and Classification of Engineering Literature.—Secondary.

MUNICIPAL AND SANITARY ENGINEERING.—PROFESSOR TALBOT AND MR. CHIPMAN

Water Supply Engineering.

Tanks, Stand-Pipes, and Reservoirs..—This subject includes the

designing and construction of these structures. Especial attention will be given to the cause of failure of stand-pipes and to requirements for safe construction. A study is made of plans of existing structures and of the methods of construction employed.

Sources and Requirements of Water Supply for a City, and Removal of Impurities.—The development and capacity of wells and other sources, standard of purity, chemical and biological action of filters, and their construction and operation.

Water Works Management and Economics.—Water works records, revenue, operation, management, franchises and their relation to the public, with a study of existing plants.

Pumps and Pumping.—Types of pumps. Design, construction, operation, duty and efficiency. Applicability of different types. Duty trials and tests.

General Water Works Construction.—When practicable a discussion will be made of of the plans and methods of construction on work with which the student has been connected.

Biological and Chemical Examination of Potable Water.—This will be given in connection with the departments of Botany and Chemistry.

Description of Water Supply Systems.—Critical discussion of water works systems from personal observation made during construction and upon the operation of similar plants.

Sewerage.

Sewage Purification.—A study of the processes and methods and of the results obtainable.

Sewage Disposal Works.—Designing. Applicability and efficiency of methods. Cost.

General Sewerage Design and Construction.—This usually involves actual work of designing and participation in the work of construction of systems of sewers.

City Sanitation.—Methods and processes of garbage reduction and disposal. Health and sanitary restrictions and measures.

Description of Sewerage Systems.—Critical examination and description from personal observations made during construction and upon the operation of sewerage systems.

Road Engineering.

Economic Aspect of Good Roads and Pavements.—An investigation of the value of road improvements.

Construction of Roads and Pavements.—Tests and require-

ments of materials. Specifications. Comparison of cost, desirability and durability. Grades and location.

Miscellaneous Subjects.

Critical Description of Engineering Construction.

Translation of Technical Engineering Work from French or German.

Any Primary in Civil Engineering.

Any Primary in Theoretical and Applied Mechanics.

Any Subject in Mathematics or Primary in Mechanical Engineering, or Electrical Engineering.—Secondary.

Analytical Mechanics.

Indexing of Municipal and Sanitary Engineering Literature in Engineering Periodicals. (Secondary.)

Resistance of Materials.

Hydraulics and Hydraulic Engineering.

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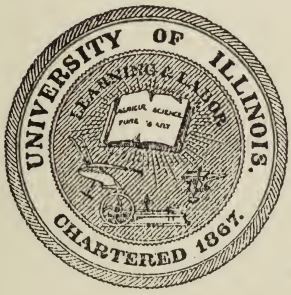
GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1898-99



GRADUATE SCHOOL

OF THE

UNVERSITY OF ILLINOIS

1898-99

POSTOFFICE:

CHAMPAIGN OR URBANA, ILL.

COUNCIL OF ADMINISTRATION.

ANDREW SLOAN DRAPER, LL.D.
President of the University

THOMAS JONATHAN BURRILL, PH.D., LL D.
Vice-President and Dean of the General Faculty and of the Graduate School

NATHAN CLIFFORD RICKER, M.ARCH.
Dean of College of Engineering

STEPHEN ALFRED FORBES, PH.D.
Dean of College of Science

DAVID KINLEY, PH.D., Secretary.
Dean of College of Literature and Arts

EUGENE DAVENPORT, M.AGR.
Dean of College of Agriculture

VIOLET DELILLE JAYNE, A.M.
Dean of Woman's Department

CALENDAR

1898–99

FALL TERM, 1898

Sept. 12, 13, Monday and Tuesday.	Registration Days.
Nov. 7, Monday.	Latest date for announcing Subjects of Theses
Dec. 14, Wednesday.	Term Examinations begin.
Dec. 16, Friday.	Term ends.

WINTER TERM, 1899.

Jan. 3, Tuesday.	Registration Day.
March 15, Wednesday.	Term Examinations begin.
March 17, Friday.	Term ends.

SPRING TERM, 1899.

March 28, Tuesday.	Registration Day.
June 1, Thursday.	Latest Day for Acceptance of Theses.
June 7, Wednesday.	Term Examinations begin.
June 11, Sunday,	Baccalaureate Address.
June 12, Monday.	Class Day.
June 13, Tuesday.	Alumni Day and Oratorical Contest.
June 14, Wednesday.	Twenty-eighth Annual Commencement.

GRADUATE SCHOOL

Organization

The graduate school is in charge of the Council of Administration of the University. The dean of the general faculty is the executive officer of the school, and he should be consulted on all matters pertaining thereto.

Admission and Registration

Graduates of the University of Illinois, and of other colleges and universities of approved standing, may apply for membership in the graduate school upon a blank furnished for the purpose. The acceptance of their credentials entitles them to enrollment. Other persons, suitably qualified, may gain admission by special vote of the Council of Administration upon such conditions as may be imposed in each case.

Registration may be accepted at any time, other than the regular registration days in September, January and March, but the time-limit required for degrees counts from the date of registration.

With the exceptions named below, all members of the graduate school are required to be in regular attendance at the University, and to do all the work for which they are registered in the departments to which such work belongs. Graduates from baccalaureate courses of the University of Illinois may register as non-resident members of the graduate school; and all members of the school who have completed the residence period required for advanced degrees may register as non-residents while completing the work required for such degrees.

Studies and Examinations

Each student must select one principal line of study, called his major subject, and upon this major subject at least one-half of his work must be done; and any greater proportion of his time, up to the whole of it, may be thus devoted if proper approval is had. When work upon the selected major subject is not arranged to require all of the student's attention, he must choose one or two minor subjects, as may be necessary to complete a full course of study.

The major study must be approved as graduate work for this University. The courses of instruction hereinafter described [p. 9] are suggested offerings. By arrangement with heads of departments other subjects may often be chosen. The minor subjects may, upon approval, be chosen from the offerings to graduates, or, except in engineering, from undergraduate courses, exclusive of those usually open to freshmen. For courses in law, a minor subject may be chosen from the Department of Public Law and Administration [p. 12].

In architectural and engineering subjects, at least the major line of study, and not less than two-thirds of the entire work, must be taken from lists marked "primary," and any remaining amount to complete a full course may be taken from those designated "secondary," under the same head with the primary list.

The head of each department in which a student does his major work is charged with the direction and supervision of such major work, and, in a general way, with the supervision of the student's entire course of study.

Instruction

In general, the instruction in courses open only to graduates consists in suggesting and directing courses of reading, in supervising investigations, and in conducting oral and written discussions. Members of the graduate school taking class work with undergraduates may be assigned extra reading or laboratory investigation. In all cases heads of departments exercise great freedom in adapting courses and methods of instruction to individual needs.

Degrees

SECOND DEGREES.—The *second* degrees conferred by the University in the Graduate School are as follows:

Master of Arts, after Bachelor of Arts.

Master of Law, after Bachelor of Law.

Master of Science, after Bachelor of Science in Agriculture and Science.

Master of Architecture, after Bachelor of Science in courses in Architecture and Architectural Engineering.

Civil Engineer, after Bachelor of Science in the course in Civil Engineering.

Electrical Engineer, after Bachelor of Science in the course in Electrical Engineering.

Mechanical Engineer, after Bachelor of Science in the course in Mechanical Engineering.

Each candidate for a second degree is required to register in the graduate school; to conform to the rules regarding registration, etc.; to pursue an approved course of study for at least one academic year in residence, or in the case of graduates of the University of Illinois for three years *in absentia;* to pass satisfactory examinations upon all the studies of the approved

course, and to present an acceptable thesis in the line of his major subject of study.

Doctor's Degree.—The degree of *Doctor of Philosophy* may be conferred upon any member of the graduate school of not less than three years' standing who shall have made high attainments in scholarship, including a sufficient knowledge of the Latin, French, and German languages to serve the purposes of research in his principal specialty; who shall have shown marked ability in some line of literary or scientific investigation; and shall have presented a thesis giving clear indications of such scholarship and of such power of research. At least the first two, or the last one, of the three years of study must be in residence at the University of Illinois, and the entire course of study must be in accordance with the regulations of the graduate school.

Fellowships

The Trustees of the University have established eight fellowships, each with a stipend of three hundred dollars, payable in ten monthly instalments.

Nominations to fellowships, accompanied by assignments to special departments of the University for instructional work, are made by the Council of Administration to the Trustees of the University, upon applications received by the President of the University each year, not later than the twenty-fifth day of April.

Nominations to fellowships are made upon the grounds of worthiness of character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Consideration is also given to the probable value or usefulness of the services of the

candidate as an assistant in instruction. Other things being equal, preference is given to those who have pursued a course of undergraduate work in which a major subject has been made a leading feature through two or more years.

Candidates must present, with their applications, full information concerning themselves and their qualifications for advanced study and research work, including any written or printed essays or results of investigation, and must name the subject in which they wish to do their major work.

Fellowships are good for one year. Appointments may not usually be renewed to the same persons, and in no case for more than one additional year; but an appointment as *honorary fellow*, without stipend, may be made as specified for paid fellowships in the case of any one who has held a regular fellowship and has shown distinguished merit in his work.

Libraries and Laboratories

The new library building, one of the best in the country, offers excellent facilities for the work therein conducted, and liberal appropriations of money make it possible in most cases to provide the necessary literature in special lines of research. There are now available to students 40,000 bound volumes and 21,000 pamphlets.

The chemical, physical, biological, geological and engineering laboratories afford abundant opportunities for research work. The agricultural experiment station and the biological station on the Illinois river, each offers special advantages for investigation. The astronomical observatory is well fitted for certain courses of practical study and research. All things

considered, the various laboratory equipments are equaled in only a few institutions in the country.

Expenses

The only fees in the graduate school are ten dollars for matriculation, from those not already matriculates of the University, and five dollars for diploma. Actual laboratory and similar expenses must be paid; otherwise there are no charges of any kind.

Board can be had in clubs and in private families at from three and a half to six dollars a week. The average price is from four to four and a half dollars.

Resident Graduates

Individuals holding bachelor degrees not desiring to enter, or not eligible for membership in, the Graduate School, may gain admission to the University as "resident graduates," and may elect such undergraduate courses as their previous training justifies. Such students may enter for a second bachelor's degree from the University.

COURSES OF INSTRUCTION.

An asterisk (*) indicates that the course it precedes is primarily for undergraduates, but is open to graduates as major work, subject to conditions prescribed by the head of the department. Courses without an asterisk are offered only to graduates.

Unless otherwise stated the work continues through the year. Information concerning the number of hours a week must be obtained by inquiry.

Indications are given under the group headings of the amount of preparatory study required for admission to the courses, expressed in years of undergraduate instruction as given in the University of Illinois, or an accepted equivalent. Of course this is exclusive of the requirements for admission to undergraduate work. In all cases admission is conditioned on the approval of the heads of the departments concerned.

LANGUAGE AND LITERATURE

Admission requirements: In Greek, Latin, French, and German, three years; in English, two years.

GREEK—PROFESSOR MOSS

Herodotus.—Selected portions for reading. Attention will be directed during the first half of the year to the text; during the second half to literary and historical criticism.

Plato.—Translation of selected dialogues, with critical study of a restricted group.

LATIN—PROFESSOR BARTON

Catullus.—Selected readings. The position of Catullus and Horace in lyric poetry; the indebtedness of Horace, Vergil and the elegiac poets to Catullus.

The Elegiac Poets.—Selections from Ovid, Propertius, and Tibullus.

Roman Literary Prose Style.—Selected readings to trace in a connected manner the characteristics of prose style under the Republic, during the time of Augustus, and under the early Empire.

ENGLISH—PROFESSOR DODGE AND ASSISTANT PROFESSOR JAYNE.

The courses in literature are:—
**Old English Poetry.*
**Fourteenth and Fifteenth Century Literature.*
**Seminary in Comparative Modern Fiction.*
**Shakespere and the History of the Drama.*
**History of English Criticism.*
**Old English (Anglo-Saxon) Grammar and Prose.*

*The linguistic courses are:—
**Early English.*
**History of the English Language.*
Icelandic.—Grammar and reading of prose.
Danish.—Grammar and reading of prose and poetry.

GERMAN—ASSOCIATE PROFESSOR RHOADES AND MR. MEYER

**Study of Goethe.*—Goethe's Life and Works, with translation and collateral reading.

**History of German Literature.*—Lectures and assigned collateral reading of English books bearing on the subject.

FRENCH—ASSISTANT PROFESSORS PIATT AND FAIRFIELD

**Eighteenth Century.*—The course will consist of: (1) Lectures in French, themes and collateral reading; reading of selected works of Voltaire, Montesquieu, Rousseau, Chènier, and Beaumarchais. (2) Assigned Readings. (3) Themes in French upon subjects connected with the course.

**Old French Readings.*—(*a*) Clèdat, Les Auteurs Français du Moyen Age; Suchier, Aucassin et Nicolete; Gautier, La Chanson de Roland. Translation and comparison with the modern idiom. Study of the laws of phonetic changes. Lectures upon Old French philology. (*b*) A systematic study of special topics: French poets of the sixteenth century. Malherbe; his school and his influence. Sacred eloquence of the seventeenth century.

PHILOSOPHY, PSYCHOLOGY AND PEDAGOGY

Admission requirements: One year.

PHILOSOPHY—ASSISTANT PROFESSOR DANIELS

**Advanced Philosophy.*—A critical study of Lotze's Microcosmus together with supplementary readings and discussions upon suggested topics.

**The Philosophy of Kant.*—A critical study of the Critique of Pure Reason and the Critique of Practical Reason.

**Esthetics.*—A brief history and a critical study of the various theories of the beautiful.

PSYCHOLOGY—DR. HYLAN

Special Investigations.—A research course consisting in the investigation of special problems.

PEDAGOGY — PROFESSOR TOMPKINS AND ASSISTANT PROFESSOR MCGILVREY

**The Psychological Factor in Educational Method.*—(a) Educational psychology. (b) The course of study. *Fall term.*

**Special Methods in Subjects*, as determined by the logic of the subject and by the learning mind. These exemplify in concrete operation all the foregoing laws. *Winter and spring terms.*

The Nature and Purpose of Education as revealed in the nature and purpose of human life, as interpreted in Literature and Philosophy.

Universal Method in Education as determined by the three organic phases of life—logical, ethical, esthetical.

The Philosophy of Method as illustrated in the teaching of various subjects.

The Philosophy of School Organization, Management, and Supervision as determined by the purpose and process of education.

Educational Ideals and Methods.—(a) Historical development; (b) present condition, problems and theories.

School Systems, past and present, as determined by their historical setting and by the educational theories of the times.

POLITICAL SCIENCE: Economics, History, and Public Law and Administration.

Admission requirements: One year.

ECONOMICS—PROFESSOR KINLEY AND DR. HAMMOND

**Money and Banking.—Winter and spring terms.*

**Public Finance.—Fall, winter and spring terms.*

**Financial History of the United States.*—The course begins with Hamilton's administration of the Treasury. *Fall and winter terms.*

**The Transportation Problem.—Spring term.*

**The Labor Problem.—Fall term.*

**The Monopoly Problem.—Winter term.*

**Theories of Production and Consumption.—Fall and winter terms.*

**Distribution of Wealth.*—This course deals rather with concrete problems of distribution than with pure theory. *Fall, winter and spring terms.*

The Theory of Value.—Special attention is paid to recent development. *Fall, winter and spring terms.*

The Theory of Distribution.—Fall, winter and spring terms.

HISTORY—ASSOCIATE PROFESSOR GREENE AND MR. ————

**American History.—Fall, winter and spring terms.*

**Mediæval History and Institutions.—Fall and winter terms.*

**The Period of the Renaissance.—Spring term.*

**English Constitutional and Legal History.—Fall, winter and spring terms.*

**The French Revolution and the Nineteenth Century.—Fall, winter and spring terms.*

**Europe from the Age of Louis XIV. to the Present Time.*

Seminary in American History.—Selected topics relating to the development of the West and its influence on national politics.

Seminary in European History.—Selected topics in the history of English institutions.

PUBLIC LAW AND ADMINISTRATION—ASSISTANT PROFESSOR TOOKE

**Comparative Constitutional Law.—Fall, winter, and spring terms.*

**Comparative Administrative Law.—Fall, winter, and spring terms.*

**International Law.—Winter and spring Terms.*

**Roman Law.—Winter and spring terms.*

**Seminary in Public Law.—Fall, winter, and spring terms.*

LAW

Admission requirements: An undergraduate course in law.

MAJOR SUBJECTS.	COLLATERAL MINOR SUBJECTS.
Law of Real Property.	Law of Personal Property.
Construction of Contracts.	Statutory Construction.
Wills and Administration.	Theory and Practice of Conveyancing.
Commercial Law.	Guaranty and Suretyship.
Law of Corporations, Private and Municipal.	Railroad or Insurance Law.

NATURAL and PHYSICAL SCIENCE and MATHEMATICS

Admission requirements: One year in Botany, Zoology, and Physics; two years in Chemistry and Mathematics; one term in Mineralogy, and two years in Geology, Physiology, and Astronomy.

BOTANY—PROFESSOR BURRILL

**Bacteriology.*—An introduction to existing knowledge upon the subject, and methods of experimentation and research.

**Systematic Botany.*—The morphology and affinities of selected groups of plants, together with studies upon life histories. *Fall and winter terms.*

**Reproduction and Development.*—Special experimental and research work in vegetable physiology and embryology. *Spring term.*

**Economic Botany.*—Useful and harmless plants, especially those affecting agricultural and horticultural interests and of prominence in the arts. *Winter term.*

Biological Botany.—Research work with living vegetation in the laboratory and field in working out special problems in the development, physiology, and pathology of plants.

Systematic Botany.—Critical and comparative studies of species included in chosen groups or from selected geographical areas.

Advanced Bacteriology.—Investigations upon morphologic and physiologic variation due to treatment; systematic studies upon the number, validity, and relationship of species; researches upon special saprophytic or parasitic kinds of bacteria and upon methods of favoring or combating their activities.

Evolution of Plants.—The influence of environment, effects of self and cross fertilization, tendencies of variation, philosophy of selection, nature and laws of heredity.

ZOÖLOGY—PROFESSOR FORBES AND DR. KOFOID

**Embryology.*—Germ cells, and the process of maturation, fertilization, cleavage, and gastrulation. The development of the chick with preparations of the amphibian embryo for comparison.

**Advanced Zoology.*—Three main lines of work are provided for: (*a*) Systematic reading of general zoology together with lectures on the morphology, physiology, and œcology of special groups. (*b*) Seminary work. (*c*) Zoölogical research work. This may be pursued at the University Biological Station on the Illinois River during the summer months.

**General Entomology.*—It is intended that the student shall come through this course competent to determine, to draw, and to describe species, and experienced in the various operations of field, laboratory, library, and economic entomology.

Advanced Entomology.—Special courses in either technical or practical entomology.

Systematic and Faunistic Zoology.—This course consists of studies of invertebrate animals (including insects) and of aquatic vertebrates, so directed as to give as nearly as possible an exhaustive knowledge of a taxonomic group or of a selected geographic assemblage.

Advanced Economic Entomology.—A research course in systematic and experimental entomology with application to insects injurious to agriculture and horticulture.

PHYSIOLOGY (HUMAN)—PROFESSOR KEMP

**Advanced Physiology.*—(*a*) The physiology of foods, digestion, and exertion; (*b*) the blood, circulation, and respiration; (*c*) the excretions, especially urine analysis; (*d*) general physiology of nerve and muscle; (*e*) advanced vertebrate, especially human, histology.

GEOLOGY AND MINERALOGY—PROFESSOR ROLFE

**Advanced Mineralogy.*—A study of the forms of crystals, and the identification of minerals by their crystalline forms. The microscopic determination of rock-forming minerals, and methods of separating the mineral constituents of fine grained rocks. *Winter and spring terms.*

**Economic Geology.*—A study of the uses man may make of geological materials, the conditions under which these materials occur, and the qualities which render them valuable.

**Advanced Economic Geology.*—The effects which variations in the chemical composition and physical constitution of inorganic substances used in the arts have on the qualities of the manufactured product, and should have no methods of manufacture. A critical examination of the tests now employed in determining the qualities of building stones.

**Paleontology.*—(a) The biological relations of fossil forms; (b) the principles of classification as applied to fossils, together with the characteristics which distinguish the larger groups; (c) the distribution and variations of the genera and species of one or more of the more important groups.

Advanced Paleontology.—A critical and comparative study of the fossils found in the rocks of Illinois.

Illinois Geology.—Glacial geology in relation to water supply of drift-covered regions. Dynamic and stratigraphic geology of the Ozark uplift in Illinois.

CHEMISTRY—PROFESSORS PALMER AND PARR, AND ASSISTANT PROFESSOR GRINDLEY

**Volumetric Analysis.*—Silicate analysis.
**Food and Air Analysis.*—Plant products, feeding stuffs.
**Technological Chemistry.*
**Physical Chemistry.*
**Iron and Steel Analysis, etc.*
**Advanced Organic Chemistry.*

**Sanitary Analysis.*—Waters, etc.

**Theoretical Chemistry.*

**Agricultural Chemistry.*

**Metallurgy.*

**Metallurgical Chemistry.*—(a) Electro-Metallurgy; (b) Electro-Chemical analysis.

**Industrial Chemistry.*—(a) Gas analysis; (b) Urine analysis; (c) Toxicology.

**Seminary.*—Journal readings, reviews, etc.

**Proximate Organic Analysis of Foods, Plants, Drugs, Compounds, etc.*—Research work in inorganic chemistry, in general organic chemistry, in agricultural chemistry, and in metallurgical chemistry, including such special topics as the composition of foods, their nutritive and heat values; the determination of the heating power of fuels, analysis of ores, etc.

PHYSICS—PROFESSOR CARMAN AND ASSISTANT PROFESSOR SAGER

**Electrical and Magnetic Measurements.*—An advanced lecture and laboratory course in the theory and use of electrical and magnetic measuring instruments.

**Advanced Physical Measurements.*—A laboratory course supplemented by recitations and lectures.

**Introduction to Theoretical Physics.*—A course of lectures and recitations, taking up dynamics, fall term; theory of electricity and magnetism, or optics, winter term; and thermodynamics or optics, spring term.

Investigation of Special Problems.—An advanced laboratory course. The student is given one or more special subjects of investigation to be conducted throughout the year.

Mathematical Physics.—A course of lectures and recitations. The subjects for 1898-99 are theory of electrical and magnetic potential, and Maxwell's theory of electricity and optics, using in the latter course Boltzmann's and Poincare's lectures as references.

Advanced Physical Measurements and Investigation.

Advanced Mathematical Physics.

ASTRONOMY—PROFESSOR MYERS

**Cosmogony.*—The chief aim of this course is to acquaint the student with the evidence for and against the Nebular Theory.

**Practical Astronomy.*—The use of instruments of precision; the determination of latitude, time, and azimuth with such instruments as are used in the ordinary practice of civil engineering.

**Theory of Orbits.*—The formation and integration of the differential equations of motion of a system of bodies and the derivation of the laws of undisturbed elliptic, parabolic, and hyperbolic motion. *Fall term.*

Special Perturbations.—An investigation of the various formulæ and methods for finding the special perturbations of a heavenly body. *Winter term.*

Celestial Mechanics.—The laws of motion of a system of bodies.

MATHEMATICS—PROFESSORS SHATTUCK AND MYERS, AND ASSOCIATE PROFESSOR TOWNSEND

Theory of Equations.—Fall term.

Theory of Determinants.—The origin and notation of determinants, properties of determinants, determinants of special forms with applications to algebra and to analytical geometry. *Winter term.*

Theory of Invariants.—The general development of the theory of invariants, both from the geometric and from the algebraic side.

Theory of Functions.—The geometric representation of the complex variable, followed by the development of the theory of infinite series, algebraic and transcendental functions, integration of uniform functions, Riemann's surfaces, introduction to elliptic functions, etc. *Fall and winter terms.*

Method of Least Squares.—Law of probability and error, adjustment of observations, precision of observations, independent and conditional observations, etc.

Analytical Geometry of Space.—A general review of the position of the plane and the right line in space and the more general properties of surfaces of the second degree, the classification and special properties of quadrics, and a brief introduction to the theory of surfaces in general. *Spring term.*

Higher Plane Curves.—The general theory of algebraic curves, together with the application of the theory of invariants to higher plane curves; special study of curves of the third and fourth order. *Winter term.*

Calculus of Variations.—Elements of the science most needed in the study of the higher subjects of mathematical astronomy and physics. *Fall term.*

Spherical Harmonics.—Fourrier's Theorem for developing any function of a variable in a series proceeding in sines and cosines of multiple of the variable is derived and the limitations of its validity investigated, followed by the study of Lagrange's, Laplace's and Larne's functions and their applications to astronomical and physical problems. *Winter term.*

Potential Function.—The potential function defined and its properties derived and discussed. The potential of various bodies, such as a wire, a spherical shell, a sphere, ellipsoid of revolution, etc., is computed. Poisson's and Laplace's Equations derived and discussed. *Spring term.*

**Modern Geometry.*—A consideration of homogeneous co-ordinates, duality, descriptive and material properties of curves, anharmonic ratios, homography, etc. *Fall term.*

**Algebraic Surfaces.*—The application of homogeneous co-ordinates and the theory of invariants to geometry of three dimensions, and also the general theory of surfaces, together with the special properties of surfaces of the third and fourth order. *Fall term.*

AGRICULTURE

Admission requirements: One year each of chemistry and of biological science.

PROFESSOR DAVENPORT AND ASSISTANT PROFESSOR HOLDEN

**Economic Agriculture.*—The influence of physical surroundings and of the elements of fertility upon the yield and the character of agricultural crops. Reaction of different crops upon the soil and upon one another when grown together or in succession. Economic sources of fertility, especially of nitrogen through the agency of bacteria.

**Soils.*—A critical study of the processes active within the soil; influence of fertilizer and of crop upon the soil; natural sources of fertility, residues of fertility, as shown by a study of drainage waters; agency of bacteria and the conditions of their activity, and the cumulative effect of manures and of various agricultural practices. *Fall term.*

**Laws of Organic Evolution as Concerned in the Breeding of Domestic Animals.*—The nature and extent of variation; natural selection; heredity; crossing; correlated variation.

**Principles of Stock Feeding.*—Functional activities of the animal body and products of their metabolism.

**Agricultural Experimentation.*—A systematic study of the work of experiment stations and experimenters in this and other countries, together with a critical study of correct principles and methods of experimentation.

**Comparative Agriculture.*—Influence of locality, climate, soil, race, customs, laws, religion, etc., upon the agriculture of a country and upon its people; influence of machinery, and of land titles; relation of agriculture to other industries and to the body politic.

ARCHITECTURE AND ENGINEERING

Admission requirements: The undergraduate course in the College of Engineering.

ARCHITECTURE AND ARCHITECTURAL ENGINEERING—PROFESSOR RICKER, ASSOCIATE PROFESSOR WHITE, AND ASSISTANT PROFESSORS MCLANE, TEMPLE

Primary. Each 1, 2 or 3 credits.

Construction of Extensive Wooden Buildings.—Foundations; floors; walls; roofs; economic spacing of columns, girders, and trusses.

Recent Uses of Stone, Brick and Terra Cotta in Architecture.—Stone columns, beams, lintels, and walls. Brick walls, piers, screen walls. Terra cotta walls, columns, architraves, cornices, internal finish.

Metallic Skeleton Buildings.—Cantilever foundations; wind-bracing; economic spacing of beams, columns, girders, and roof trusses; economics of arrangement and construction.

Fire-Resisting and Fire-Proof Buildings.—Methods of construction used and proposed; results of tests and fires; comparative returns from investments.

Sanitation of Public Buildings.—Water supply and sewerage of isolated buildings; examination of examples; proposal of improvements; estimates of cost.

Researches on Evolution of Architectural Styles.—Development of column, pier, entablature, window and door; changes in uses of architectural elements; modifications in plans, elevations and uses of buildings; influence of climate, materials, and man; progressive decoration.

Higher Application of Graphic Statics.—The kern and compression; statics of Gothic structures; steel and tile or concrete vaults and dams; deflection curves of loaded beams and girders; economics of large roofs.

Heating and Ventilation of Large Buildings.—Comparison of systems; study of executed examples; designing plant for isolated public buildings; economics of heating and ventilation.

Higher Studies in Architectural Design.—The work of an entire term will be devoted to a single problem, a large public or semi-public building; the design will be most important, but sufficient attention must be paid to construction, heating, lighting, etc.

Researches and Experiments in Applied Esthetics.—Application of theories of geometrical proportions to selected buildings; measurement of proportions of architectural elements in best styles; experiments in variations.

Translation of Architectural Works from French or German.—Summary data; condensations; complete translations in clear, idiomatic English.

Secondary. Mostly 1 credit each.

Stereotomy Applied to American Problems.—Arches, straight

or skew; vaults, groin or cloister; domes and pendentives; staircases and stairway vaults.

Examinations of Heating and Ventilation of Buildings.—1, 2, or 3 credits. Inspection of completed plants and reports thereon; tests of apparatus; efficiency of arrangements; economy of working.

Higher Workshop Practice.—Inspection of wood-working mills, of architecttral iron works, of marble works, terra cotta works, examination of processes employed and reports thereon.

Photography for Architects.—Theory and practice of dry plate photography; making negatives of exteriors, interiors, details, and drawings; printing processes.

Methods of Reproducing Drawings and Specifications.—Hektograph, mimeograph, blue prints, black prints, colored prints, other processes; drawing for photographic processes.

Higher Problems and Methods in Perspective.—1, 2 or 3 credits. Shadows in perspective; oblique perspective; abbreviated methods; reflections.

Estimates and Specifications for Large Buildings.—Study of examples; collection of data; general and detailed estimates; outline and complete specifications.

Higher Industrial Design.—1 or 2 credits. Sketches and working drawings for furniture and ornamental work for buildings.

Advanced Water Color Painting.—Rendering in ink, sepia, or color.

Office Methods and Arrangement.—Arrangement of offices for architects; storage of supplies and of drawing of completed work; filing drawings, specifications, etc., of work in progress; book-keeping for buildings; forms of official papers.

Any Primary Offered in Engineering Subjects.

Indexing and Classification of Periodicals, Books, etc.—Collecting and filing data; decimal system; materials; arrangement of clippings; indexing periodicals, filing drawings.

CIVIL ENGINEERING—PROFESSOR BAKER AND ASSISTANT PROFESSOR PENCE

All subjects are primary unless otherwise stated.

Railway Engineering

Location and Construction.—Advanced work in the economic theory of railway location with relation to the effects of distance, grade, and curve upon operation and maintenance. Estimates, specifications and contracts, and the improvement of existing lines of railway.

Railway Track and Structures, and Their Maintenance.—The design of track standards and of minor railroad structures, trestles,

culverts, turn-tables, water tanks, engine houses, etc., with special reference to economic principles of construction and maintenance.

Yards and Terminals.—The arrangement of tracks, buildings, etc., at division and terminal points with reference to economy and facility in handling traffic. Personal inspection and report on actual cases.

Motive Power and Rolling Stock.—Locomotive construction and performance, and car building and repairs.

Signal Engineering.—A study of the various systems of railway signaling. Personal inspections and comparisons of different plants in actual operation.

Railway Operation and Management.—The organization and administration of the several branches of service in railway operation.

Structural Engineering

Bridge Design.—A comparative study of the details of standard designs, with personal inspection of the process of manufacture and erection.

Cantilever and Swing Bridges.—The computation of stresses, design of parts, method of erection, etc.

Metallic Arches.—Computation of stresses and design of metallic arches.

Metallic Building Construction.—The computations and drawings of a design for a metal skeleton building, with a consideration of standard connections.

Roof Construction.—Computations of stresses and designs of steel roof trusses.

Stereotomy.

History of the Development of Bridge Building.—Secondary.

Miscellaneous Subjects

Practical Astronomy.—Practice with the astronomical transit zenith telescope, and alt-azimuth in determining time, latitude, and azimuth.

Geodesy.—A study of the methods employed in triangulation, with practice in reading angles; base-line measurements: method of least squares and adjustments of triangulation systems; map projection; trigonometrical leveling.

Critical Description of Engineering Construction.—Details of methods and cost from personal inspection during progress of construction.

Translation of Technical Engineering Work from French or German.

Any Primary in Theoretical and Applied Mechanics, or Municipal and Sanitary Engineering.

Any Subject in Mathematics, or any primary in Mechanical Engineering, or Electrical Engineering—Secondary.

Indexing of Civil Engineering Periodical Literature.

ELECTRICAL ENGINEERING—PROFESSOR CARMAN, ASSISTANT PROFESSORS SWENSON AND ESTY

Mathematical Theory of Electricity and Magnetism.—Lectures and recitations with Mascart and Joubert's Electricity and Magnetism as text book.

Absolute Measurements in Electricity and Magnetism.—Laboratory course in investigation of special problems.

Dynamo Electric Machinery.—Laboratory course in the study of some of the machines belonging to the department, including alternating current apparatus.

Electric Transmission of Power.—Course of lectures, with study and design of electric stations according to the best engineering practice.

Electro-Metallurgy.

Photometry.

In addition to the above courses. minor courses may be taken in mathematics, physics, chemistry, and in any of the engineering courses.

MECHANICAL ENGINEERING—PROFESSOR BRECKENRIDGE AND ASSISTANT PROFESSOR VANDERVOORT

Advanced Machine Design.—The work offered under this head embraces a wide range of subjects, and will be arranged along any special line that may be considered profitable for the student.

Graphics and Kinematics.—The application of graphical methods of solutions of problems; advanced valve-gear problems; acceleration and velocity diagrams of governors; quick return motions, other important mechanisms.

Mill Engineering.—A study of problems arising in connection with installation of power plants and transmission of power.

Steam Engineering.—A study of theory and practice of steam generation and use. This may be taken as applied to marine practice, to locomotive practice, to steam heating, or to stationary steam engines and boilers. Advanced study of theory of the steam jacket and of superheating; multiple expansion engines; steam turbines.

Experimental Engineering.—Review of standard methods of testing applied to all forms of motors or steam generating apparatus. Numerous experiments and carefully prepared reports are required.

Thermodynamics.—Advanced study of theory of heat engines. Solution of numerous problems.

Pneumatics.—A study of air compressors and of air transmis-

sion; air motors; blowing engines; fans and blowers. Theory of design and operation. Problems.

Hydraulic Machinery.—A study of high and low duty pumping engines; hydraulic transmission of power: centrifugal and rotary pumps; hydraulic presses, elevators, and cranes.

Mechanical Technology.—Installation and economic arrangement of machinery. Shop management and systems. Construction of special machine tools. Construction of machinery used in various lines of manufacturing.

Translation of Technical Engineering Literature.

Any Primary Offered in the College of Engineering.—Secondary.

Indexing and Classification of Engineering Literature.—Secondary.

MUNICIPAL AND SANITARY ENGINEERING—PROFESSOR TALBOT

Water Supply Engineering.

Tanks, Stand-Pipes, and Reservoirs.—This subject includes the designing and construction of these structures. Especial attention will be given to the cause of failure of stand-pipes and to requirements for safe construction. A study is made of plans of existing structures and of the methods of construction employed.

Sources and Requirements of Water Supply for a City, and Removal of Impurities.—The development and capacity of wells and other sources, standard of purity, chemical and biological action of filters, and their construction and operation.

Water Works Management and Economics.—Water works records, revenue, operation, management, franchises and their relation to the public, with a study of existing plants.

Pumps and Pumping.—Types of pumps. Design, construction, operation, duty and efficiency. Applicability of different types. Duty trials and tests.

General Water Works Construction.—When practicable a discussion will be made of the plans and methods of construction on work with which the student has been connected.

Biological and Chemical Examination of Potable Water.—This will be given in connection with the departments of Botany and Chemistry.

Description of Water Supply Systems.—Critical discussion of water works systems from personal observation made during construction and upon the operation of similar plants.

Sewerage.

Sewage Purification.—A study of the process and methods and of the results obtainable.

Sewage Disposal Works.—Designing. Applicability and efficiency of methods. Cost.

General Sewerage Design and Construction—This usually involves actual work of designing and participation in the work of construction of systems of sewers.

City Sanitation.—Methods and processes of garbage reduction and disposal. Health and sanitary restrictions and measures.

Description of Sewerage Systems.—Critical examination and description from personal observations made during construction and upon the operation of sewerage systems.

Road Engineering.

Economic Aspect of Good Roads and Pavements.—An investigation of the value of road improvements.

Construction of Roads and Pavements.—Tests and requirements of materials. Specifications. Comparison of cost, desirability and durability. Grades and location.

Miscellaneous Subjects.

Critical Description of Engineering Construction.

Translation of Technical Engineering Work from French or German.

Any Primary in Civil Engineering.

Any Primary in Theoretical and Applied Mechanics.

Any Subject in Mathematics or Primary in Mechanical Engineering, or Electrical Engineering.—Secondary.

Analytical Mechanics.

Indexing of Municipal and Sanitary Engineering Literature in Engineering Periodicals. (Secondary.)

Resistance of Materials.

Hydraulics and Hydraulic Engineering.

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